Ensemble simulations for climate change adaptation of the Swedish guidelines for design floods for dams

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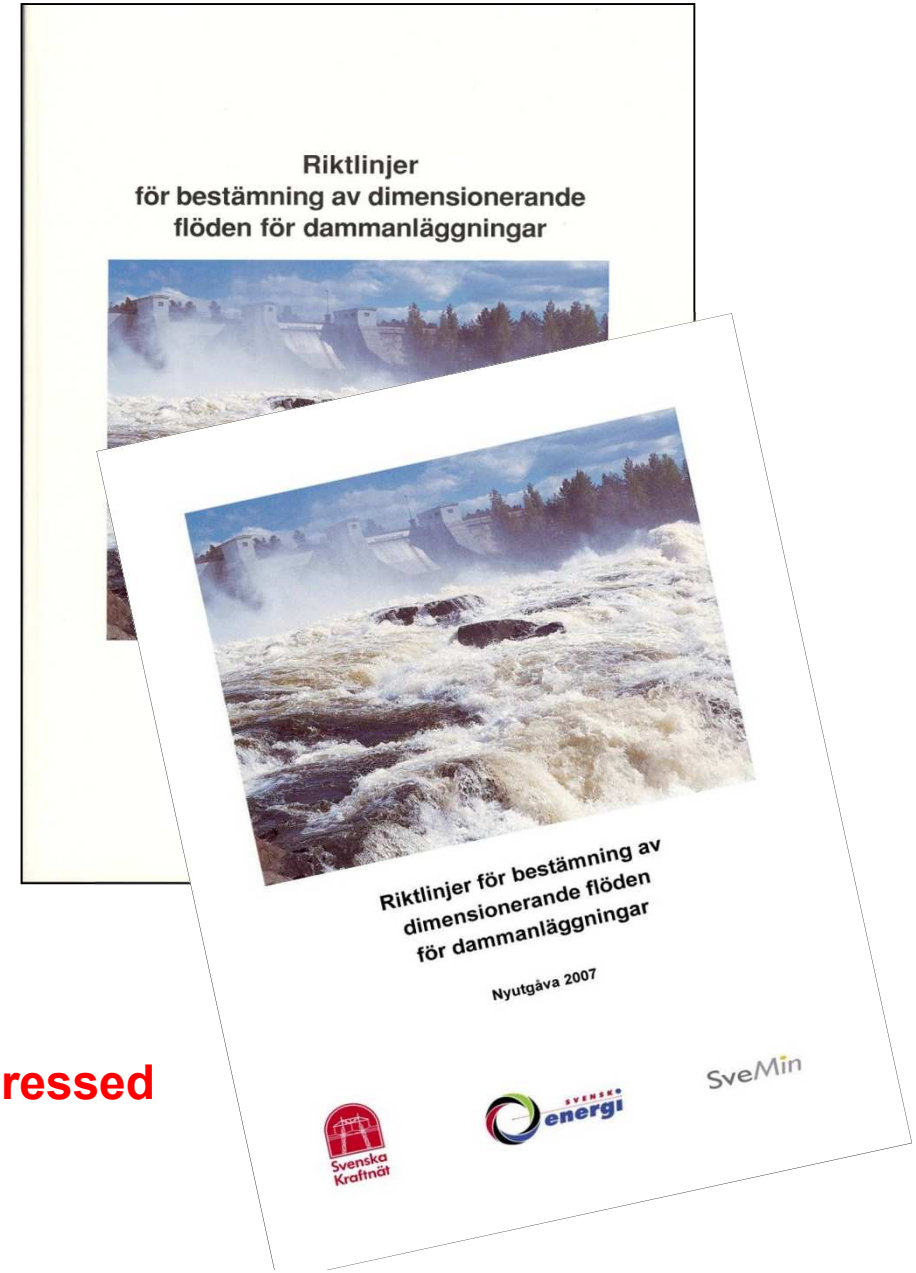
Hydropredict 2012, Vienna

The Swedish guidelines for design floods for dams

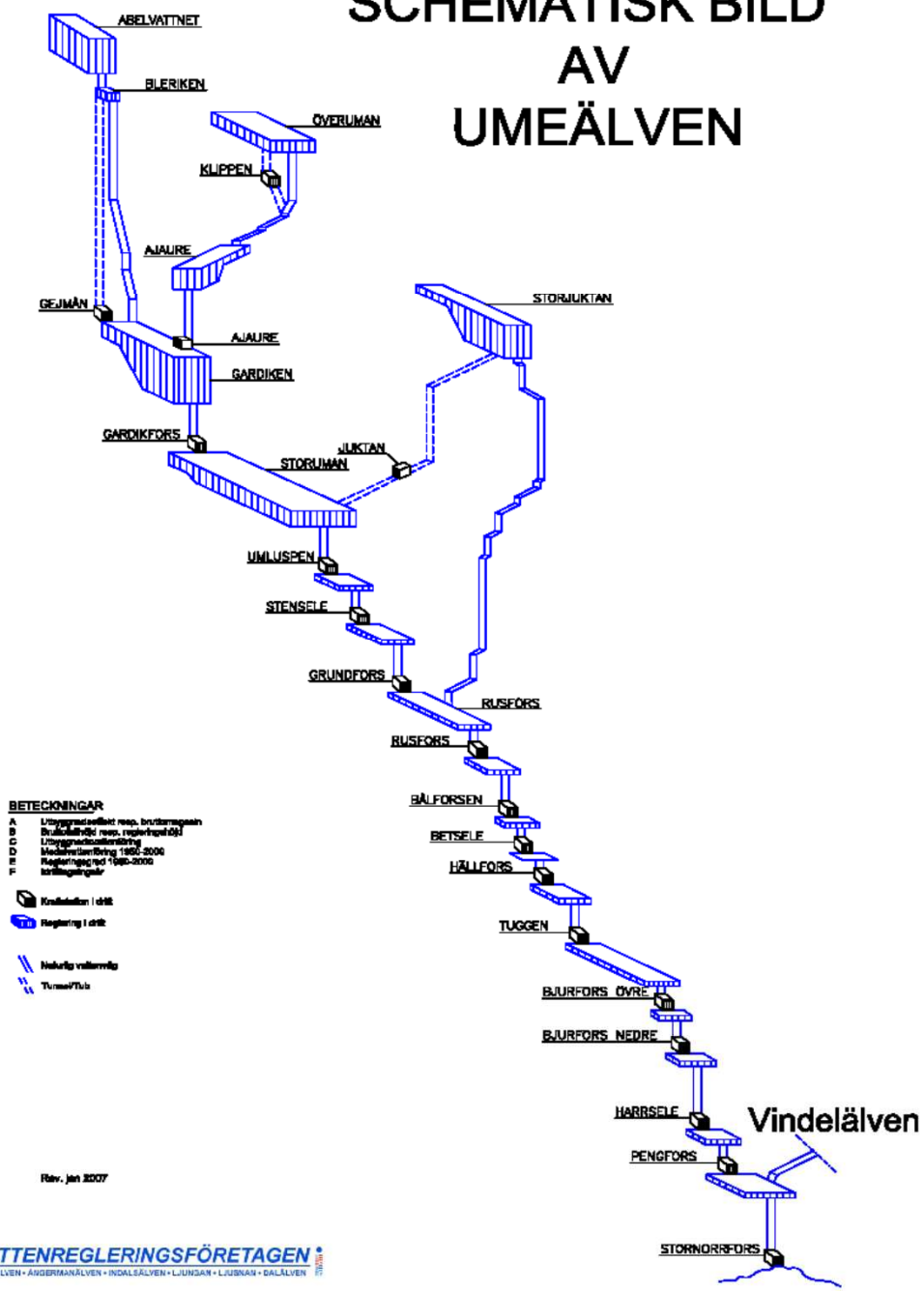
First edition in1990



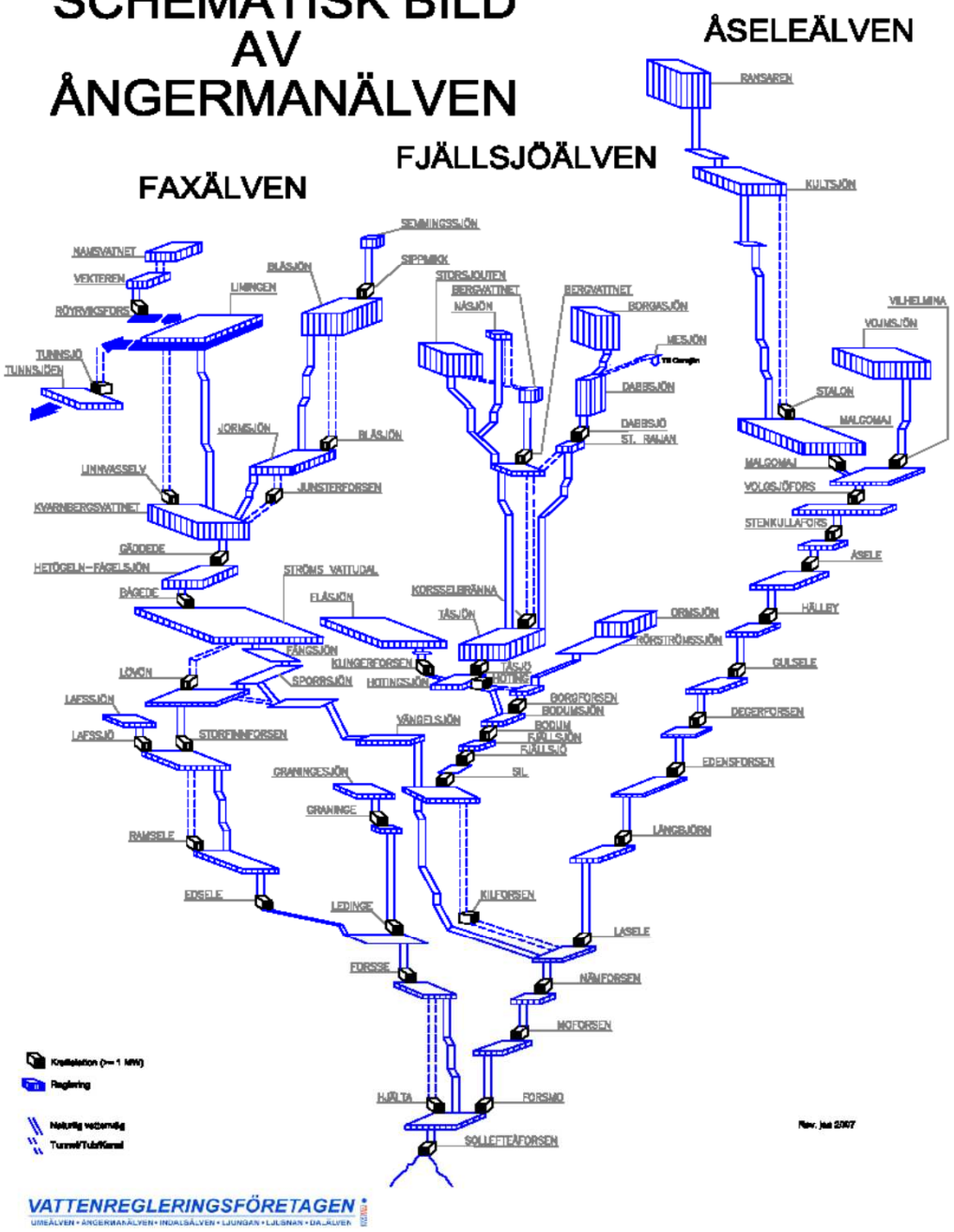
New edition in 2007

Climate Change is addressed

SCHEMATISK BILD AV UMEÄLVEN



SCHEMATISK BILD AV ÅNGERMANÄLVEN



Two design categories, depending on the consequences of a dam failure:

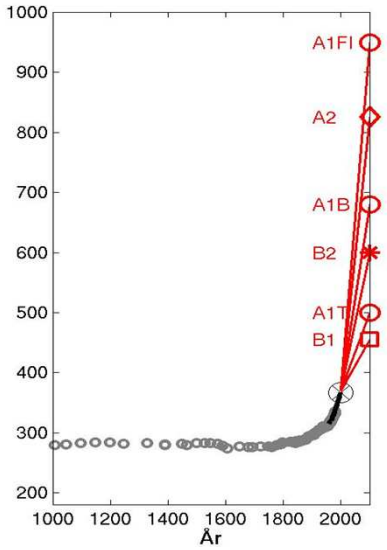
Category I (high hazard) is based on hydrological modelling and simulations of the river system.

Category II (low hazard) is based on statistical methods (frequency analysis).

From emissions to regional climate projections

SMHI

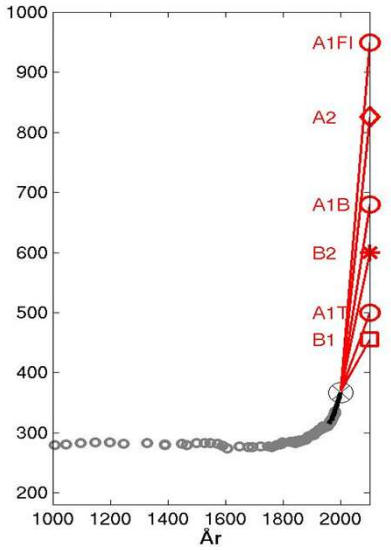
Emissions

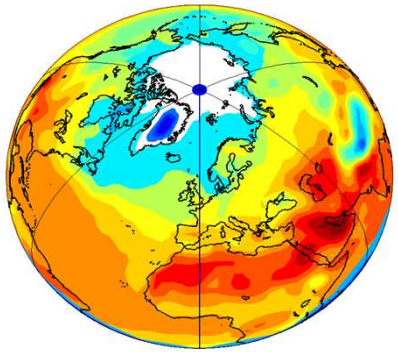


From emissions to regional climate projections

Emissions

Global climate model

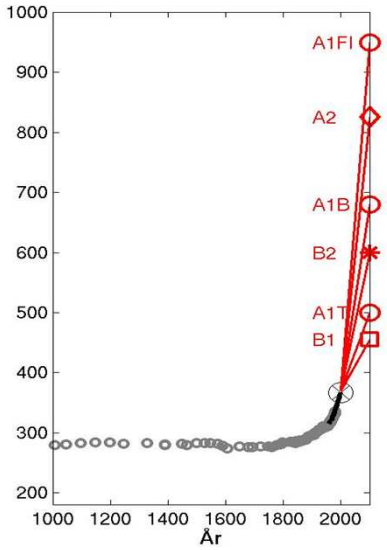




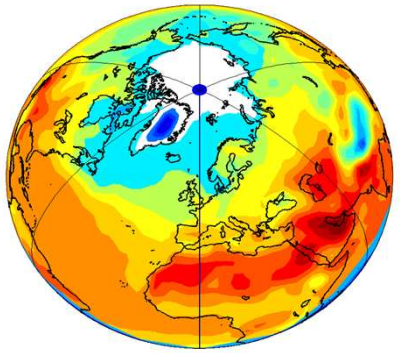
From emissions to to regional climate projections

SMHI

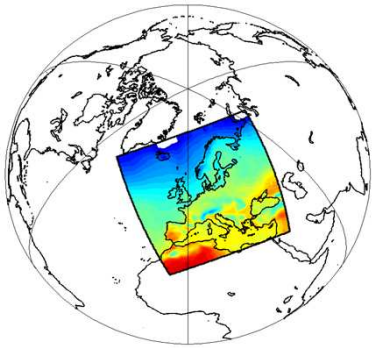
Emissions

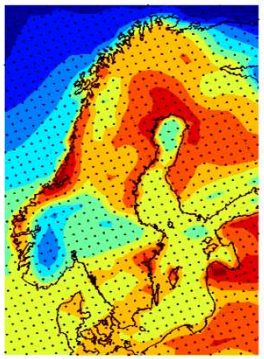


Global climate model



Regional climate model

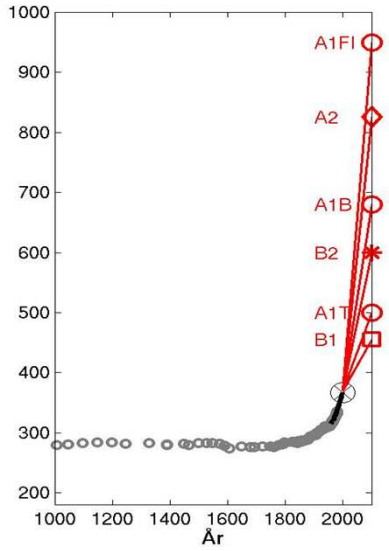




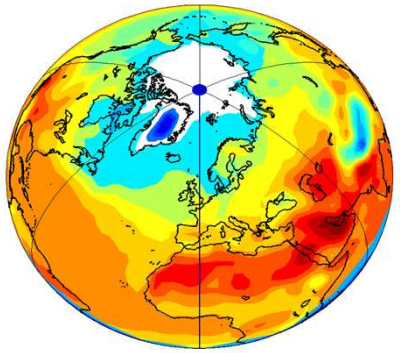
From emissions to design floods

SMHI

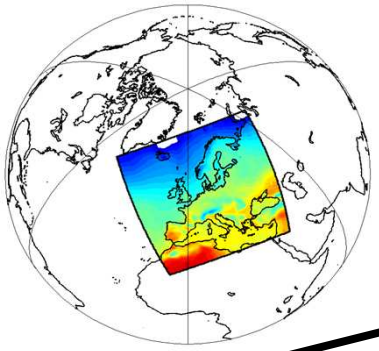
Emissions

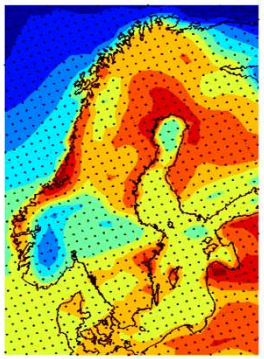


Global climate model



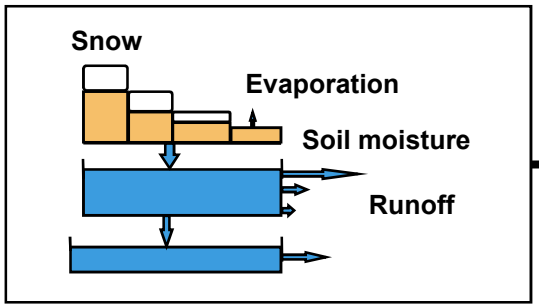
Regional climate model





Scaling

Hydrological model



Calculation of design flood

Summary of 16 regional climate scenarios used

Emission Scenario	Global Climate Model (GCM)	Regional Climate Model (RCM)	Resolution	Period simulated	Comments on the GCMs
A1B	ECHAM5(1)	RCA3	50 km	1961-2100	(1) denotes No 1 of 3 different initial conditions
A1B	ECHAM5(2)	RCA3	50 km	1961-2100	(2) denotes No 2 of 3 different initial conditions
A1B	ECHAM5(3)	RCA3	50 km	1961-2100	(3) denotes No 3 of 3 different initial conditions
A1B	ECHAM5(3)	RCA3	25 km	1961-2100	(3) denotes No 3 of 3 different initial conditions
A1B	CNRM	RCA3	50 km	1961-2100	
A1B	CCSM3	RCA3	50 km	1961-2100	
A1B	CNRM	Aladin	25 km	1961-2050	
A1B	ECHAM5(3)	RACMO	25 km	1961-2100	(3) denotes No 3 of 3 different initial conditions
A1B	ECHAM5(3)	REMO	25 km	1961-2100	(3) denotes No 3 of 3 different initial conditions
A1B	HadCM3(Q0)	HadRM3	25 km	1961-2100	(Q0) denotes medium climate sensitivity sit sensitivity
A1B	HadCM3(Q16)	RCA3	25 km	1961-2100	(Q16) denotes high climate sensitivity
A1B	BCM	HIRHAM	25 km	1961-2050	
A1B	HadCM3(Q0)	HIRHAM	25 km	1961-2050	(Q0) denotes medium climate sensitivity
A1B	ECHAM5(3)	HIRHAM	25 km	1961-2100	(3) denotes No 3 of 3 different initial conditions
B1	ECHAM5(1)	RCA3	50 km	1961-2100	(1) denotes No 1 of 3 different initial conditions
A2	ECHAM5(3)	RCA3	25 km	1961-2050	(3) denotes No 3 of 3 different initial conditions

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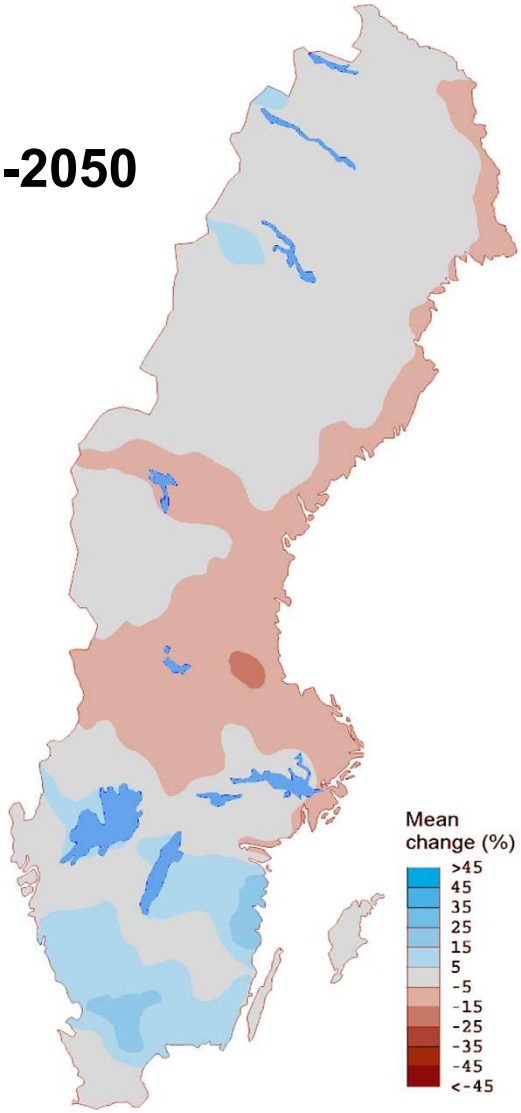
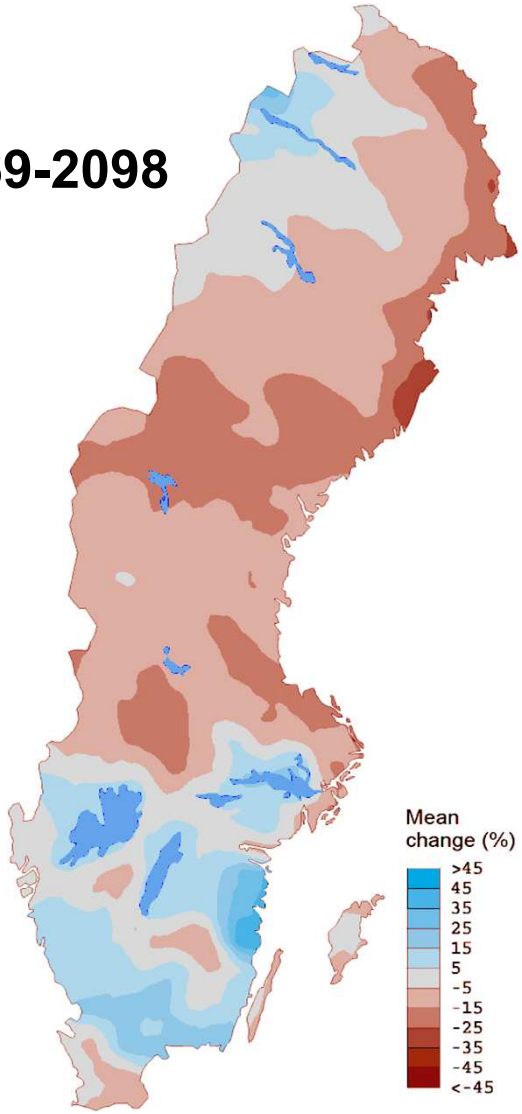
Change in the 100-year flood from 1963-1992…

…until 2021-2050



Mean of 16 climate scenarios

…until 2069-2098



Mean of 12 climate scenarios

Calculation scheme for Flood Design Category I

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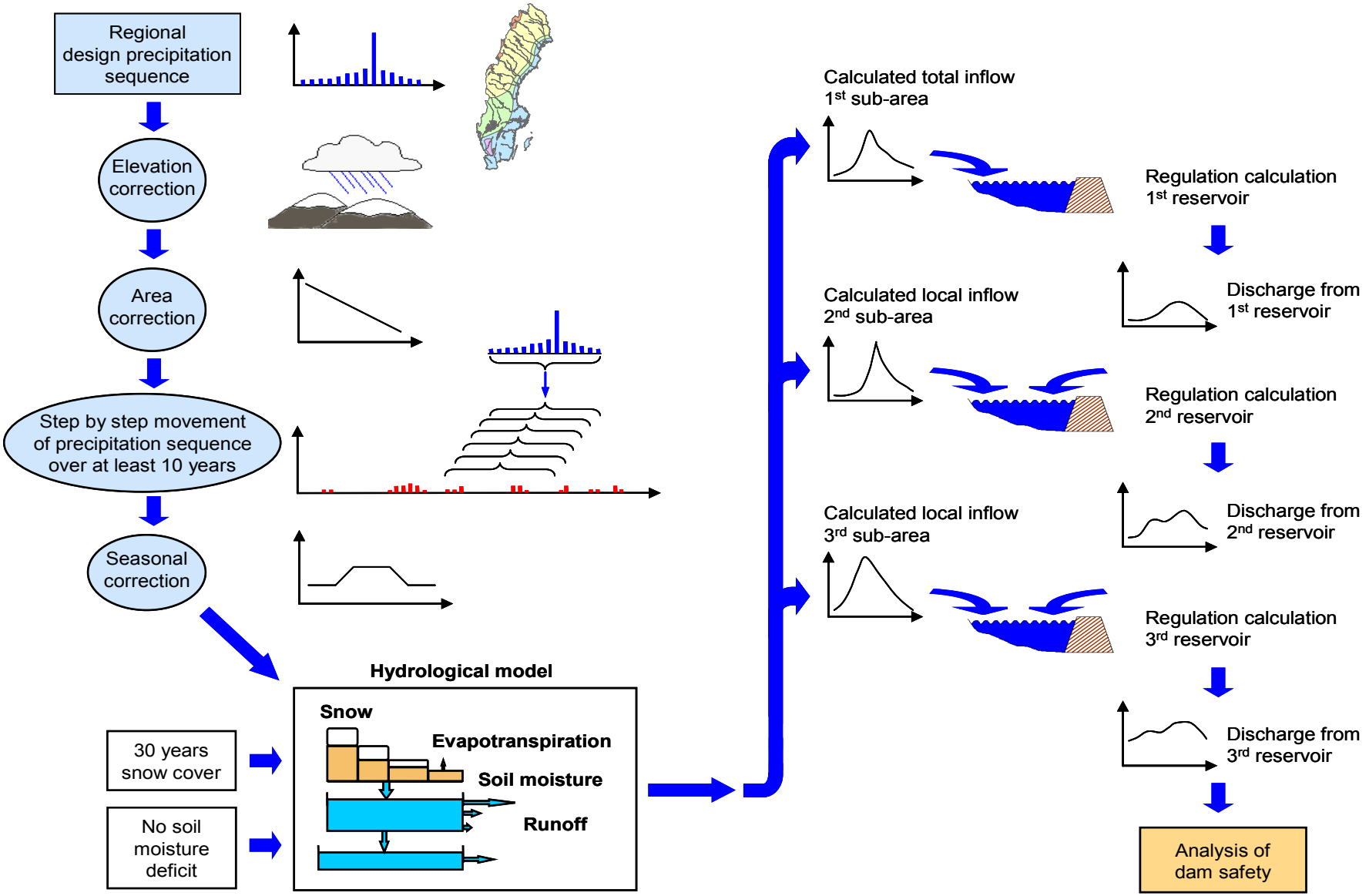
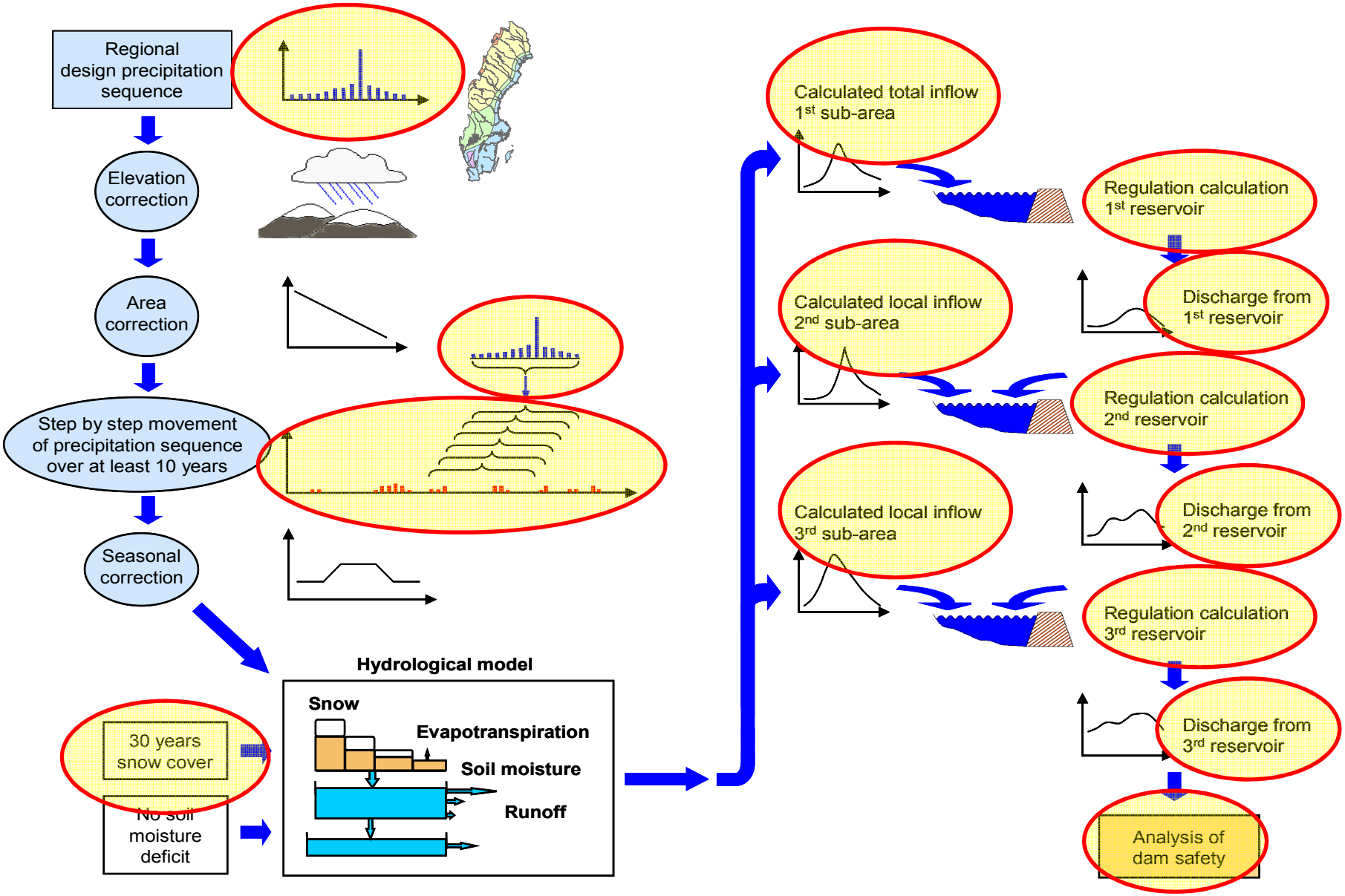


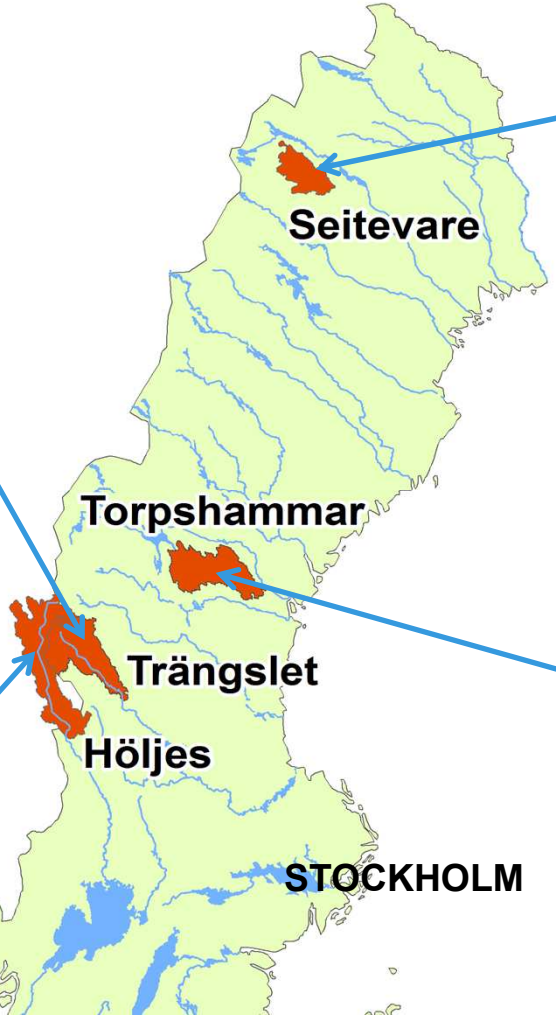
Components affected by climate change

SMHI

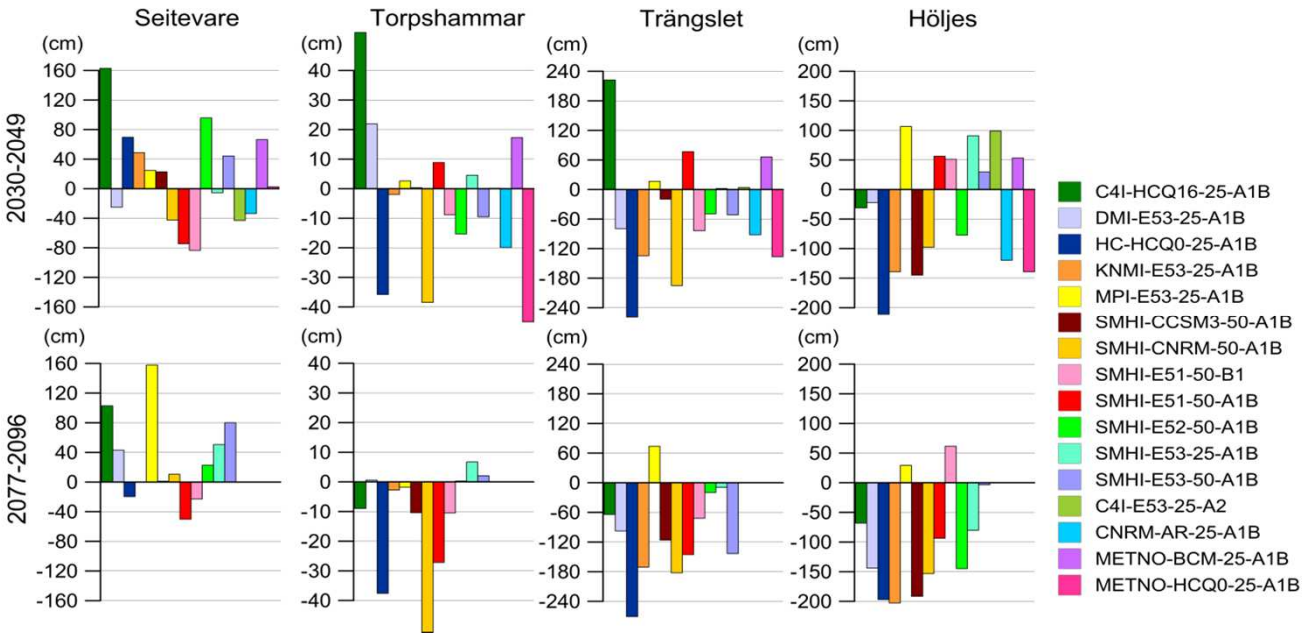


4 test basins out of a total of 11

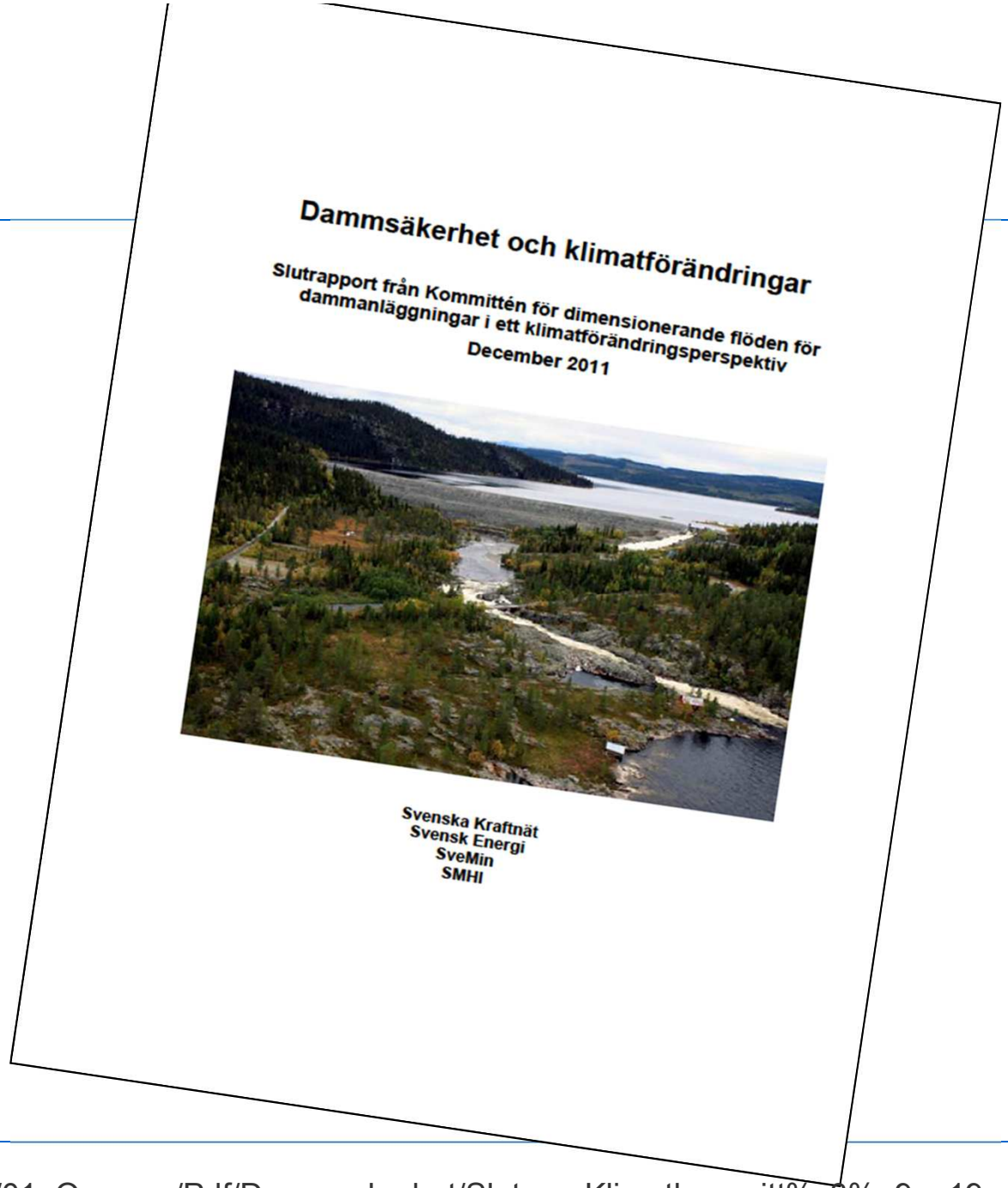
SMHI



Summary of the simulated effects on the changes in the design reservoir levels for the four reservoirs



The ”Climate Committee” set up by the power and mining industries, the dam safety authority and SMHI.



http://www.svk.se/Global/01_Om_oss/Pdf/Dammsakerhet/Slutrap_Klimatkommitt%c3%a9n_19_dec.pdf

Concluding remarks

- A technique for climate change adaptation of Swedish design flood guidelines has been developed.

- The use of an ensemble of regional climate scenarios is recommended (at least 10).

- A continous scientific evaluation is needed as to which climate scenarios to use.

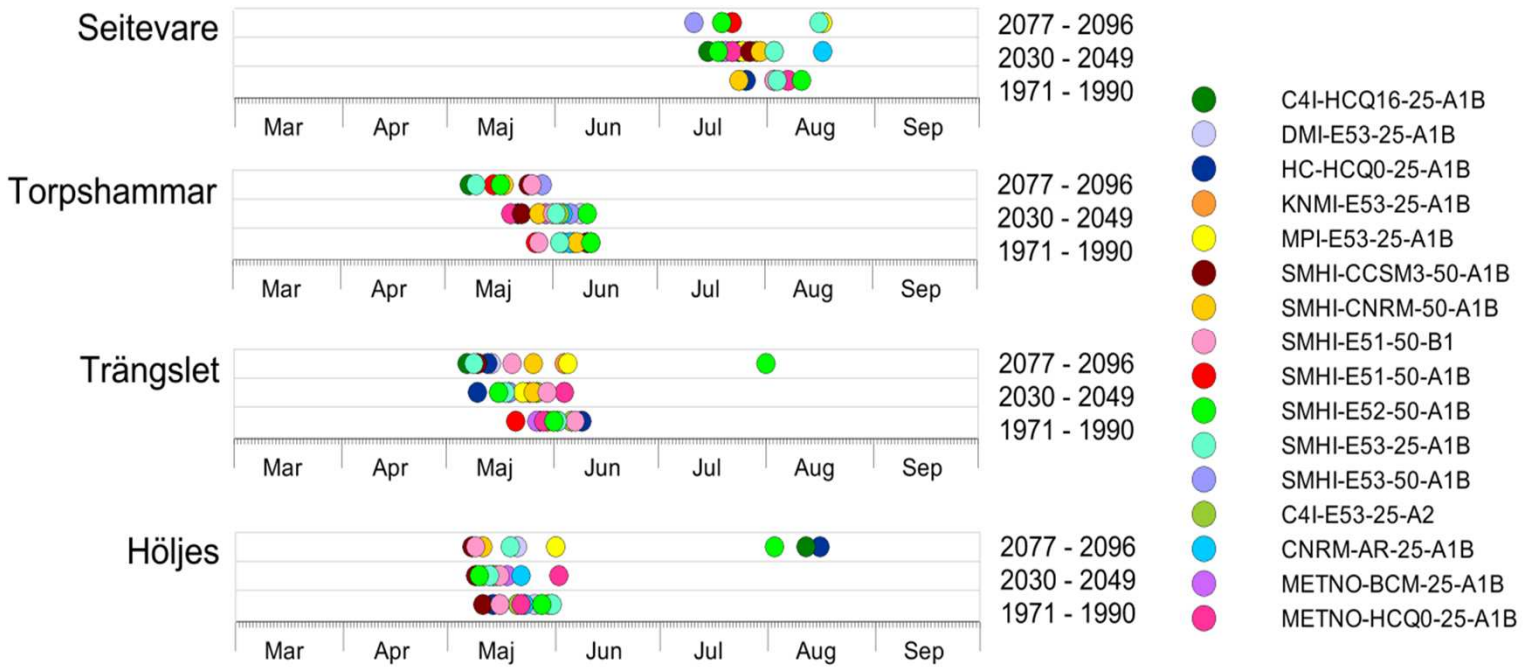
- Tests show that the technique can be applied with reasonable efforts.

- Tests show that the results are site-specific, therefore each system has to be analysed individually.

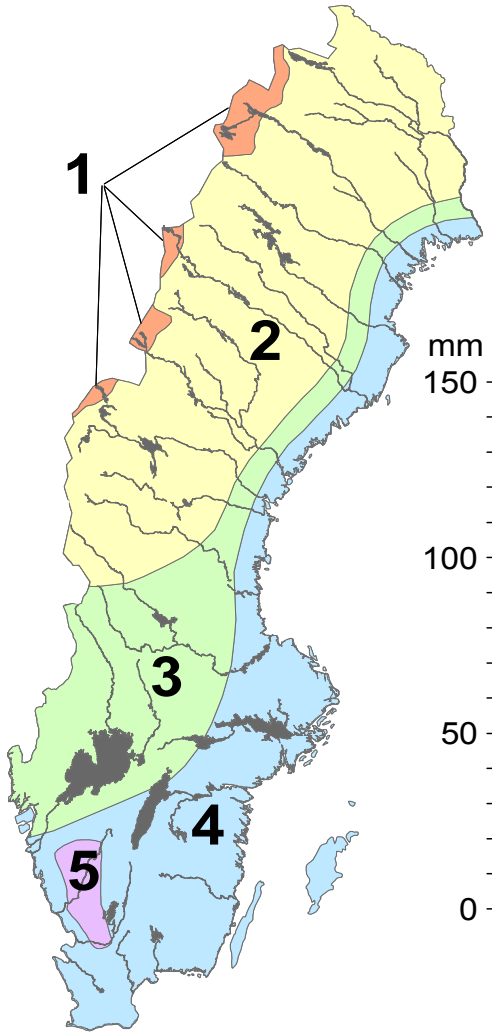
- Tests show that the uncertainty due to climate change is greater than due to other parts in the modelling process for design floods.

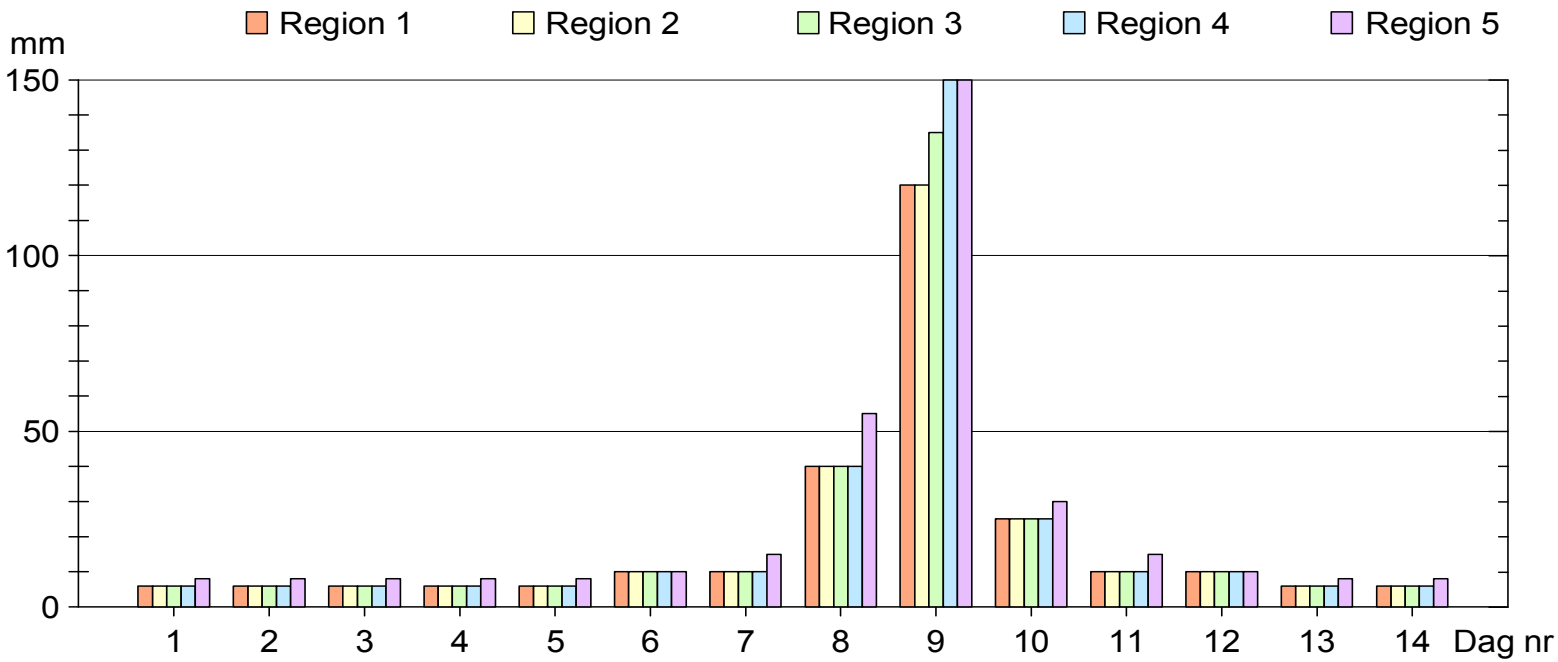

Thank you for your attention!

The time in a year when the design level is calculated to be reached in the different simulations



Regions and design precipitation sequences (mm/24h)





Change in the design precipitation sequence in region 2